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AUTHOR Suprise, S. J.; Mitchell, N. L.
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ABSTRACT

Although interactive video instruction is a powerful educational tool which provides students practical and engaging experiences in the classroom, its effectiveness depends upon its pedagogical design and strategic instructional use. In order to utilize the established advantages of interactive video instruction, instructional designers must apply what is known about how people learn to the development of this instructional medium. This paper identifies common themes in learning theory that have practical design implications for the instructional designer of interactive video modules. The following guidelines extracted from these theories are suggested to increase the effectiveness and appropriate use of interactive video instruction: (1) prepare the learner; (2) attract and direct the learner's attention; (3) guide the learner through successive steps of complexity; (4) present the material repeatedly in a variety of contexts; (5) provide a vehicle for practice with immediate feedback; and (6) make connections between new information and old information. (Contains 13 references.) (Author)

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Effective Use of Video in Interactive Modules

S. J. SUPRISE
Enzian Technology, Inc.
3251 Progress Drive, Suite A, Orlando, FL 32826, USA

N. L. MITCHELL
Director, Instructional Systems
Rollins College, 1000 Holt Avenue - 2647, Winter Park, FL 32789, USA

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Abstract: Although interactive video instruction offers a powerful educational tool with which to provide students practical and engaging experiences in the classroom, its effectiveness depends upon its pedagogical design and strategic instructional use. In order to utilize the established advantages of interactive video instruction, instructional designers must apply what we know about how people learn to the development of this instructional medium. This article identifies common themes in learning theory that have practical design implications for the instructional designer of interactive video modules. The following "guidelines," extracted from these pertinent theories, are suggested to increase the effectiveness and appropriate use of IV instruction: 1) prepare the learner, 2) attract and direct the learner's attention, 3) guide the learner through successive steps of complexity, 4) present the material repeatedly in a variety of contexts, 5) provide a vehicle for practice with immediate feedback, and 6) make connections between new information and old information, showing how it fits into the "big picture."

In a generation of learners raised with television, music videos, and video games, it is no wonder that video has been hailed as a remedy to education's weaknesses. Many instructional developers boast of innovative applications for the myriad of new video "toys" available to media developers, and empirical studies validate the claim that interactive video instruction is effective. But because technology has made it so easy to incorporate video into educational materials, it is often incorporated haphazardly or misused. As with the development of all interactive educational programs, the integration of media must be done with pedagogical purpose and strategic instructional design. To facilitate the transfer of information and to provide an effective learning environment, we must adhere to sound instructional design principles, and use an appropriate medium to fit the instructional objectives, not mold the instruction to fit the tool.

Empirical Studies Discuss the Use of Interactive Video Instruction

Recent studies indicate that interactive video is generally an effective and efficient instructional medium. For example, interactive video instruction has been shown to be 30 percent or more efficient than lecture, also yielding greater retention rates than typical group instruction (Brandt, 1990). Dowding's literature review (1991) revealed that interactive video instruction led to a 40 percent reduction in training time with a 40 percent reduction in error rate; other studies report figures as high as 50-70 percent. Smith and Lehman's (1988) review of many interactive video programs yielded

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similar results, substantiating the claim that video training programs are efficient and generally as effective as traditional training methods.

Additionally, researchers report many other benefits of this media. Interactive video instruction generally holds students' attention as much as 34 minutes longer than "traditional" lecture methods (Petty & Rosen, 1987). Students also may access interactive video programs independently, progress through instruction at their own pace, and repeat segments or the entire program as desired (Garrett & Savage, 1990). By creating an environment where students are active participants in the learning process, they ultimately become accountable for their own learning (Nelson & Watson, 1991).

However, some suggest that video itself has no more impact on learning than any other media. Clark (1983) believes that "media are delivery vehicles for instruction and do not directly influence learning" (p. 453). Smith and Lehman (1988) state "that it may be the design of effective materials rather than the medium itself that produces the [research] effect" (p. 29). We believe *that it is the design of video materials and the way in which they are used in instruction that actually makes them effective, rather than an inherent quality of the medium itself.* Although research studies reveal the apparent effectiveness of interactive video, more research is needed to determine *how* it can be effectively used and *for which* learners and learning tasks it is optimal. As Tannenbaum and Yukl (1992) state, "Empirical research to determine how different features of the high technology methods facilitate training has lagged far behind development of the technology itself" (p. 433).

The Appropriate Use of Interactive Video Instruction

It seems clear that video alone cannot solve all of education's problems, especially when it is used inappropriately, and in fact, it is often misused. Video clips that are nothing more than a view of a narrator talking to the camera, merely a "talking head", have little educational value and the instruction could be accomplished with lecture or audiotape. Yoshii, Milne, & Bork (1992) found that presenting long video segments of factual information to students before requiring any interaction tends to leave them uncertain about where to focus their attention and about which features were the most salient (p. 4). This is an inherent problem in the lecture method that interactive computer programs were meant to alleviate. As Brandt (1990) points out, "The danger in the continued use of weak designs is that someday, if interactive video becomes prevalent, it may be accused of the same shortcomings that school systems are being accused of today" (p. 10).

Another common misuse of interactive video is the use of an inappropriate level of interactivity. Interactivity means that the user actively participates in the learning situation and has at least some amount of control of the information presented. The learner's responses are usually used to further tailor the instruction to the learner's needs or to provide feedback by showing the consequences of one's choices (Petty & Rosen, 1987).

Video may be integrated into computer-based instructional programs at various levels of interactivity, each with its own advantages. Some instructional tasks require higher degrees of interactivity than others, just as some learners require more participation and activity in the learning process than others. At the lowest level, interactivity is typically limited to stopping or restarting a video segment. This level is all that is necessary when using video to place a concept into a relevant context, or to help students visualize concepts which are difficult to explain verbally. For example, short clips of scientific phenomena and procedures are especially effective for illustrating cause-and-effect relationships that would otherwise require laboratory demonstrations. Video segments are also valuable in a social work curriculum where students can view interaction in a real therapy session, allowing them to reflect on nonverbal behavior, proper questioning techniques, and group leadership skills without the pressure of guiding the actual sessions.

A second degree of interactivity gives the learner full control of the video presentation, with the ability to stop and start the video, rewind to a specific segment, or pause on a specific frame. This level of interactivity is useful in several contexts. In a classroom presentation, the teacher may first present a video segment to prepare the learner and to create the appropriate context for the topic. Then the teacher may pause the video, repeat certain segments or frames, and emphasize or explain critical features to which the learner may not have attend. In an interactive video program designed as an out-of-class exercise, students can repeat specific segments that were not clear when viewed

initially, explore the segment again while attending to details, or merely pause and reflect on the new material before proceeding.

The highest interactivity level allows the learner to respond to video, altering what is seen and heard. Artificial intelligence incorporated into a computer program branches the learner to a specific video segment based on his or her response. Such highly interactive strategies also allow programs to collect information about student progress and provide feedback accordingly. This facilitates guided exploration, practice with immediate feedback, and opportunities for students to meaningfully apply what was learned in a non-threatening environment.

For example, in the Education Department of the University of Michigan, Professor Carl Berger created an "interactive fiction" project called Klepto (Staff, 1992, p.15). This videodisc is composed of a series of scenes in which a hypothetical classroom incident--in one case, the discovery of some missing classroom equipment--provides the viewer with a series of choices about how to handle the problem. After seeing a video segment, the viewer is required to make a series of decisions about how to respond to the incident. Through program branching, the viewer can observe various outcomes of their choices; "Each choice will lead a participant to specific consequences. The goal of the program is not to suggest a *right* way to handle a specific classroom problem, but to serve as a catalyst for class discussion and exploration of consequences of different responses" (p. 15).

Some other appropriate uses of interactive video instruction have been suggested by Dowding (1991). He maintains that interactive video instruction can be effectively used to 1) simulate operational consoles, in which students can practice actual operations on simulated equipment; 2) teach concepts and skills when immediate, objective, or visual feedback is required; and 3) teach knowledge or skills that could be enhanced through the use of visualization. For these uses, interactive video "can be used in the classroom to describe basic system characteristics, capabilities, and limitations; to show background and operational theories and principles; and to demonstrate complex relationships" (p. 308).

Interactive video instruction is particularly effective for training motor skills, procedures, or processes. Dowding (1991) states, for example, that interactive video is "extremely effective in providing instruction and performance in advanced operations and tactical decision-making through simulation of tactical situations" (p. 308). For these tasks, interactive video instruction can utilize behavioral modeling techniques to teach procedures or skills. The required skill or procedure can be displayed through a video presentation, an "expert" can demonstrate the correct performance while clearly delineating each step, and then students can be required to practice the procedure through simulation of the operation (p. 308).

The ultimate purpose of education and training is to enable students to use the skills and knowledge gained in the classroom to accomplish meaningful goals in the real world. Interactive video instruction that closely simulates that real-world environment can prepare students for those experiences. Interactive videodisc instruction can allow students to practice performing operations or to learn processes that are normally difficult or impossible to safely execute in the real world until the student has gained considerable skill and experience. For example, interactive video incorporating real footage is often used to train pilots to land a plane under emergency situations. Or, it is used to train students in the classroom to perform tasks that require expensive, easily damaged equipment or the execution of potentially hazardous procedures. In an educational environment, this type of interactivity permits students to freely investigate phenomena such as chemical reactions, in significantly less time than required for traditional laboratory exploration (Hoffer, et al., 1992).

The Incorporation of Instructional Design Principles

Consequently, for video to truly be a useful educational tool, it must be used for those educational tasks for which it is best suited and incorporated a level of interactivity that facilitates the maximum amount of learning possible. However, as Smith and Lehman (1988) warn, in order to use interactive video to create effective educational products, sound instructional design principles must be also be used.

In a previous article (Mitchell, Suprise, & Ray, 1993), we outlined several teaching principles that apply to the development of instructional materials. These important guidelines are based on

information from many disciplines, such as Learning Theory, Information Processing and Problem Solving, Perception, Graphic Design, Cartography, and Instructional Design. Although often articulated with different terminology, there appear to be some teaching principles common to these perspectives: 1) prepare the learner, 2) attract and direct the learner's attention, 3) guide the learner through successive steps of complexity, 4) present the material repeatedly in a variety of contexts, 5) provide a vehicle for practice with immediate feedback, and 6) make connections between new information and old information, showing how it fits into the "big picture." These guidelines help ensure that the learner's attention is focused on the appropriate information, that the concept is presented in different context to promote generalization, that the learner has an opportunity to apply and interact with the information, and that this process will be mediated by guidance and frequent feedback. Thus, these six principles represent a condensation of the learning theory literature articulated as "design tips" backed by decades of empirical research and practical use. These principles may be particularly helpful when designing interactive video instruction.

Prepare the learner

Video can be used, for example, to prepare the learner by placing new information into a context that is relevant to students. It is motivating for students to see a relationship between what is presented in class and what occurs in their own lives. For example, by beginning a lesson on sleep physiology with a short video clip that relates sleep deprivation, a common problem for students, to alcohol use can make the study of this topic more interesting and engaging for students.

Attract and direct the learner's attention

Video also seems to naturally attract students' attention, but as we have previously discussed, with a minimal level of interactivity, it can also serve as a medium to help distinguish critical features of a new concept. Often, what appears obvious to the educator, may not be so obvious to students. Showing an appropriate video clip, and then returning to segments and discussing the salient features that are depicted can help students sort through and focus on the most important points.

Guide the learner through successive steps of complexity

Video can be used to guide learners through successive steps of complexity, reinforcing accomplishments as they proceed. As compared to the mere linear presentation of content, the incorporation of video allows the learner to progress from introductory clips that create a context for new concepts, to video segments that show applications of the concepts to real world problems, to interactive exercises that allow students to interact with video to practice what they have learned. In the sleep deprivation example cited above, video is used to guide the learner through deeper levels of understanding by first showing several circumstances under which sleep deprivation is studied, methods used to measure brain wave components during sleep, and finally still motion video frames depicting wave components present in sleep patterns. Students are encouraged to visualize more and more complex applications of these ideas and are given an opportunity to "measure" brain waves.

Present material repeatedly in a variety of contexts

Video can also facilitate learning through the incorporation of successive clips that place new content in varied contexts. Digitized video now allows designers to incorporate short clips from many sources into one seamless instructional piece. These "repeated presentations" have significant effects on cognitive development (Hoffer et al., 1992). Research has shown that when successive examples of concepts are separated in time, they are less likely to be active in working memory at once (Anderson, 1981, cited in Hoffer et al., 1992, p. 10). When students can observe effects in only a few minutes via interactive video, they are more likely to recognize patterns in the results unlikely to be seen in the fragmented view of the typical classroom or laboratory environment. Also, repeated presentations of concepts in varied contexts facilitates generalization.

Provide a vehicle for practice with immediate feedback

Most importantly, students need an opportunity to apply this new information in a meaningful way, not just as an isolated homework assignment, but through a variety of strategies that also provide immediate feedback for their efforts. A video program created by Dr. Michael Valentine (Knapp-Minick, Gottron, & Loven, 1991) called "Talk To Me Teacher" represents an excellent example of video used to provide hands-on practice with learned material. In this example, video is used by students to practice effective communication skills for classroom discipline. A video segment is presented showing a typical disruptive classroom incident. As the teacher in the video attempts to diffuse disruptive behavior, the student records any instances of unclear communication displayed by the teacher. Then the student is given a choice of statements to use to intervene and immediately sees the effects of this choice; either the disruptive behavior ceases or escalates. Students can practice classroom intervention and communication skills in a non-threatening environment, repeat the exercise, and receive immediate feedback regarding their progress.

Make connections between new information and old information

Finally, implementing these instructional principles helps to ensure that students make connections between what they have learned in the past to new information, helping them to formulate "the big picture" and to show how each element fits. These interconnections enable learners to combine ideas, infer, extrapolate, or otherwise reason from them and thus formulate concepts "beyond the information given" (Bruner, 1973, cited in Hoffer et al., 1992). Video is an especially effective tool for helping students make these connections because it can present real life applications of concepts that could not otherwise be created in the classroom. As Dede (1987) concludes, "A delivery system of visual media capable of supporting learner interactivity while at the same time facilitating interconnectivity of images and symbols has the potential to become an extremely powerful education tool" (cited in Hoffer et al., 1992).

In conclusion, when approaching an instructional need, it is important to carefully consider the different instructional media available to determine how that need could best be satisfied. In some cases, interactive video instruction will satisfy that need; in some cases, it will not. Yet, video designers and computer developers often apply this emerging and promising technology to many instructional problems based on its known merit and unquestionable power. The result is a very expensive interactive video module that yields "no significant difference" or that results in learning that is equivalent to what could have been accomplished through simple stand-up classroom instruction or laboratory work.

Therefore, video can be an effective educational tool if it is used for those applications for which it is best suited; to introduce material, to help learners visualize the key points of a concept, to relate them to other concepts, and to help students see real world applications of ideas explored in the classroom. Furthermore, video must be incorporated into the lesson with strategic planning according to accepted principles of instructional design. It can be used to promote understanding by attracting and directing students' attention to critical features of the material, by placing it in a context that is familiar to them and which gradually increases in complexity, and by allowing an opportunity for students to apply this information to promote connections to what they already know. If these principles are carefully applied to the design of video in interactive modules, educators can begin to capture its powerful educational effects.

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